MCO 299

HOSPITAL DESIGN NOTE

DIMENSIONAL CO-ORDINATION AND INDUSTRIALISED BUILDING

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Dimensional Co-ordination and Industrialised Building

CONTENTS

I Introduction to the series.

II Scope.

III General implications of industrialised building principles.

IV Functional requirements.

V Range of preferred increments.

VI Common reference technique for the location of components.

VII Use of reference grids.

VIII Selection of components.

IX Implementation.

Appendix: Glossary of terms.

I. Introduction to the series

1. This Note is one of a series of Design Notes applicable to the hospital building programme and to some extent to the local authority health and welfare building programme.* In this Note a distinction is made between Health and Welfare Buildings. The latter, and also staff residential accommodation (houses, flats, etc.), will usually be designed in accordance with techniques applicable in the housing field, which are described in publications by the Ministry of Housing and Local Government.

2. The stages to be followed in planning and executing hospital projects are described in the Ministry of Health document "The Programming of Hospital Building Projects." Design Notes provide guidance on the problems which arise and the techniques to be used in the later stages, i.e. those concerned with sketch plans, working drawings and the preparation of contract information and tender documents.

3. The results of work presently being carried out by Inter-Regional Hospital Boards Study Groups (see section IX of this Note) will be published in Design Notes.

II. Scope

4. This Note is intended to provide an introduction to the application of industrialised building techniques to hospital (and some types of local authority health and welfare) buildings. It discusses:

(a) the general principles affecting, and the basic information required for, the design and construction of dimensionally co-ordinated buildings and components whether the latter are made on the site or factory produced;

(*b*) recommendations to relate the use of traditional materials and the design of factory-made standard components in a system of dimensional co-ordination;

(*c*) the relevance to hospital building of the recommendations on the use of preferred increments published in February 1963, in the Ministry of Public Building and Works Statement D.C.1, "Dimensional Co-ordination for Industrialised Building";

(*d*) and describes the work of the Study Groups which are examining the practical problems of applying industrialised building techniques to the hospital building programme.

III. General implications of industrialised building principles

5. The successful achievement of the building programme proposed in "A Hospital Plan for England and Wales" will be greatly assisted by the use of new techniques in both design and construction. Rationalisation of the processes of design of hospitals and health and welfare buildings is made possible by the application of the guidance in the current series of Building Notes. So far as construction is concerned, traditional building methods are likely to prove inadequate to cope with the increasing demands made on the industry. This factor among others has led to the rapid development of a variety of industrialised building processes involving a large measure of fabrication in the factory, where work can be undertaken in a controlled environment. On site, organisation aims at the quick assembly of finished components by the minimum labour force.

6. To enable components produced in several factories to fit together with a minimum of site labour, cutting and jointing, and to facilitate their combination with traditional and other on-site components, it is essential to ensure that the dimensions of the components are co-ordinated with each other. This co-ordination will permit the requirements of the designer to be reconciled with those of the manufacturer and constructor and the following benefits can ensue:

(*a*) designs based on universally accepted dimensions can be more easily visualised and understood, particularly by the user;

(*b*) the general content of drawings can be simplified and time saved by the designers in the preparation of contract drawings;

(*c*) orders for components can be placed well in advance of need, thus creating the right conditions for effective control of production and delivery;

(*d*) consistent use of a limited range of components will encourage controlled performance testing. Modifications found necessary from their use in practice can be fed back to the designers and manufacturers, and incorporated in future phases of a programme of buildings designed on the same dimensional principles;

(*e*) the extension of factory production makes for

* See Ministry of Health Local Authority Building Notes.

more economic use of mechanical plant for construction assembly on site;

(*f*) the location, spaces required and integration of mechanical engineering services is especially important in hospital buildings and a technique of co-ordinating dimensions provides a simple dimensional frame of reference to accommodate these factors; mechanical services can therefore be related to the structure at an early stage in planning and this can lead to more standardisation, with a consequent reduction of cost in design time and in the supply and installation of the services;

(*g*) shorter ranges of components will permit early cost planning and experiment with new contractural methods;

(*h*) with the establishment of standard ranges of dimensionally co-ordinated components manufacturers are assured of continuity of production: building and engineering contractors are able to simplify setting out on the site and utilise to the full their skills in assembly methods; and the user has a finished product developed as a result of widely based co-operative studies and prototype testing.

7. The requirements basic to the use of industrialised building techniques are:

(a) a clear brief on the functional requirements which the building is to satisfy;

(b) the use of preferred increments in the design of spaces and components;

(c) the selection of a technique to relate components to each other;

(d) the use of preferred dimensions in the design and production of ranges of dimensionally co-ordinated components and the variety reduction of all components.

(e) administrative measures to ensure the effective use of these new techniques by architects, engineers, quantity surveyors and industry.

These factors are dealt with separately in the following sections.

8. The Appendix gives a glossary of terms.

IV. Functional requirements

9. Two major considerations have to be borne in mind:

(i) the functions which the end-product (the hospital or health building) is required to perform; and

(ii) the need to accommodate future changes in these functions, even though the nature of these changes cannot be foreseen with any precision.

10. Functional requirements for hospital buildings are reflected in the decisions taken at each of the stages of planning and building (see "The Programming of Hospital Building Projects"). The need to provide in design for changes in the use to which the spaces within hospital buildings are put is imposed by the rapid and continuous changes which occur in medical and nursing practice. In effect, the hospital is to be regarded in this context as an aggregation of spaces, capable (within limits) of a number of alternative uses. The extent to which this consideration can be reflected in actual design depends on the solutions available to the following:

(i) Study of user requirements, anthropometric data and the rationalisation of spaces;

(ii) Practicable design techniques, e.g. depth/length ratios;

(iii) Grouping of like user functions to allow for limited internal adjustment;

(iv) Standardisation of layout and extension techniques for mechanical services;

(v) Provision for future lateral or vertical growth of particular departments;

(vi) Assessment of probable trends, e.g. it is probable that over a period of years the demand for specialist diagnostic and treatment facilities will increase;

(vii) Design of components to achieve interchangeability when functions change.

V. Range of preferred increments

11. The prime need of industrialised building is to evolve a technique for the dimensional co-ordination of the spaces and components commonly required for the building programme. This technique must be based essentially on the use of a range of preferred increments and both must be used to develop standard and dimensionally co-ordinated components.

12. The range of preferred increments upon which dimensional co-ordination in the hospital building field is to be based has been described in the Ministry of Public Building and Works Statement D.C.1, "Dimensional Co-ordination for Industrialised Building". Extracts especially relevant to hospital building are shown in italics below:

13. *One inch preferred increment: "This is proposed as the minimum increment of overall thickness and size of section of finished components for all purposes other than tolerance and fit."*

14. *Four inch preferred increment:* "The four inch preferred increment is intended as the *least increment in the overall sizing of non-structural components generally.*"

15. *One foot preferred increment and multiples of one foot: "The one foot dimension is proposed for structural and carcassing components* other than in size of section or thickness." In practice multiples of one foot will be specifically identified.

16. Use of three inches for specific purposes: This dimension has been identified, but is not a preferred increment. The use of three inches can only be determined after the development of further studies.

17. *It is intended that ranges of preferred dimensions should eventually be worked out for the most important components and spaces in buildings. In each case the range of preferred dimensions will be based on a previously chosen "least increment". This least increment will be chosen from the preferred increments described above and the choice will depend on the nature and functions of the component or space and the task it has to perform.*

18. The principles involved in the selection of preferred dimensions are described in Section VII of this Note, and the studies now being conducted on their application in hospital design are described in Section IX.

VI. Common reference technique for the location of components

19. On the basis of these three preferred increments it is necessary to identify a technique for dimensional co-ordination capable of use in the design of hospital and local authority health building, and in the selection and location of components for these buildings.

20. At present, two principal techniques can be distinguished:

(*a*) the use of a structural grid, the size of which will be derived from analysis of the user requirements (mainly anthropometric and operational data) to provide a general dimensional control within which, by reference to the dimensions of a limited range of components, the design is developed from the area of greatest complexity in layout and juxtaposition of structures, spaces, components and services. This technique is useful, for example, in cross wall designs where the area of decision is comparatively limited (see Bulletin, Ministry of Housing and Local Government);

(*b*) to use a series of reference meshes related to the 4 ins. and 1 ft. preferred increments which are either implicit or used as grids. Space and components are related to the mesh in each plane.

21. It is unnecessary to examine the first of these methods in detail, since the scale and complexity of work required in hospital building are such that it is of only limited utility. This Note therefore concentrates (in Section VII) on the application of reference meshes or grids to the design of hospitals and local authority health buildings (particularly clinics and buildings for sub-normal adults and children).

VII. Use of reference grids

(a) General

22. The technique of mesh or grid reference in the design of buildings is not new. In general, grids have two principal functions:

(*a*) to define spaces and the general location of components

(*b*) to define the detailed assembly of components.

Their use should not dictate the content or form of the whole. In the first case a large grid or grids is used, its size depending on the function of the assembly considered. In the second case a smaller grid is needed.

23. The grid technique provides a discipline for accommodating both currently available materials and components and new components designed to preferred dimensions within a framework of space sizes. In consequence, the use of a larger grid (or grids) makes for simplicity and speed of decision in the design stage and the use of a related smaller grid simplifies the development of working assembly or component drawings.

24. To achieve the necessary relationship between the grid sizes all grid intervals should be inter-related and the lowest common and acceptable dimension is the basic increment of 4 ins. (See paragraphs 13-16 above.) If this dimension is used as the basis for all reference grids, whether used for the location and detailed arrangement of structures, or smaller components, the conditions are at once established for the design of a building whose dimensions are wholly co-ordinated with each other, and with other buildings using the same technique.

25. Three principal reference grids are recommended:

(i) basic grid;
(ii) planning grid;
(iii) structural grid.

(i) *Basic grid*

26. This is to be visualised as a three-dimensional (i.e. cubiform) mesh, with the planes of each space four inches from each other. The volume within which the mesh will be used will be determined by the size of the planning grid used (see para. 29 below) and the preferred vertical dimensions employed (see para. 39 below) both of which will be derived from the 1 ft. increment. Subject to these limitations the basic grid is used to locate components in the space(s) occupied by it: the simplest example of its use is where the outer faces of a component (or a number of components used together) are located so as to coincide with the planes of the basic grid.

27. In practice, the location of assemblies of components will be determined by reference to the planning grid, and the principal value of the basic grid is to permit the precise location of components at points of complexity where the assembly will often consist of a number of individual components used together. Thus it will normally only be necessary to draw the basic grid lines in large-scale detailed drawings to illustrate the inter-relation of components used at these points of complexity.

28. The principles of locating components within the mesh of the 4 in. increment and the derived 1 ft. increments will also provide for precise and comparative calculation of the quantities (and therefore the costs) of each of the components and material used in them, and ensures that the complete assembly will fit into any building designed on these principles. The advantages of this to the manufacturer, architect, quantity surveyor and contractor are obvious.

(ii) *Planning grid*

29. This is a two-dimensional reference grid applied to the horizontal plane in the design, laying out and sizing of rooms and spaces. It provides a frame of reference for the assembly of larger components, particularly those used in combination, and identifies the areas of complexity which require to be defined by the basic grid.

30. With the planning grid dimensionally related to the basic grid, sketch plans are easily and speedily translated into working details, and components readily identified and cross referenced.

31. It is important to note that planning grids are intended to establish the horizontal relationship between spaces, and to permit the rapid development of general location drawings. The practice of horizontally sizing components directly from planning grids, while it has advantages for proprietary (i.e. "closed") building systems, inhibits achievement of the full advantages of a universal (i.e. "open") system of industrialised building based on common and co-ordinated dimensions. Of these advantages, interchangeability of components serving the same function between one building type and another is the most significant, and its achievement is one of the prime objectives of the Government policy of establishing a national range of preferred dimensions.

32. Thus the selection of sizes for dimensionally co-ordinated components (apart from main dimensions for structural and carcassing components) is not dependent on the size of planning grid.

(iii) *Structural grid*

33. The use of a structural grid to determine the position on plan of the main load-bearing components is common practice. Although in general terms the size of the structural grid need not be an exact multiple of the planning grid size nor coincide with it, coincidence achieves the maximum simplicity.

(b) Preferred dimensions for the reference grids used in hospital design

(i) *Basic grid*

34. This is based on the 4 ins. increment.

(ii) *Planning grid*

35. Earlier discussion on the use of planning grids in the design of hospital building led to a recommendation by the Ministry that the 1 ft. 4 ins./2 ft. 8 ins. planning grid seemed to meet the optimum number of hospital design requirements. As a result, this grid has been used extensively in the design of hospital buildings at present on the drawing board, or nearing or under construction. However, the Ministry of Public Building and Works Statement D.C.1 (see Section V above) recommends the use of multiples of 1 ft. for structural and carcassing components and the recommendations in the Statement have been accepted for the purposes of the hospital building programme. The size of the planning grid affects the selection of dimensions for structural and carcassing components, and therefore the recommended 1 ft. increment has a bearing on the size of the planning grid to be used in hospital design work. Thus, and especially as co-ordination between different building programmes is extended, a planning grid related to multiples of the 1 ft. increment (e.g. a 2 ft. 0 in. – 3 ft. 0 in. grid) will be increasingly used in the design of hospital building.

(iii) *Structural grid*

36. Precise recommendation on the size of a structural grid or grids, or on depths/span ratios for hospital building, cannot be made until the report of the Inter-Board Study Group on structures has been completed (see Section IX).

37. In the past the Ministry has recommended 21 ft. 4 ins. and 22 ft. 8 ins. as the lateral dimensions for a structural grid appropriate to hospital building. The use of multiples of 1 ft., as recommended in the Ministry of Public Building and Works Statement, however, means that 22 ft. 0 in. becomes the nearest preferred dimension for this purpose.

38. The Inter-Board Study Group will also seek to establish further preferred grid dimensions and a standard range of spans and beams. The cross-sectional size of beams is not critical since (in hospitals) they are usually enclosed within the total depth of floor envelopes. Depending on the location technique cross-sectional sizes of columns based on increments of 4 ins. will ensure that co-ordinated spaces are left for in-filling components, although it is possible to use increments of 2 ins. and 1 in., but these increments will demand care in the co-ordination of components.

(iv) *Vertical dimensions*

39. Overall storey heights and floor envelope depths in hospital buildings should be in increments of 1 ft. if the maximum simplicity in the application of components affected by vertical dimensions (e.g. doors, partitions) is to be achieved. The adoption of this increment will also enable progress to be made in the standardisation of the dimensions of windows and external cladding, partitions, doors, staircases and related components.

40. Functional studies and development work have demonstrated that the majority of hospital departments can be accommodated in clear room heights of 8 ft., 9 ft., or 10 ft. except for gymnasia, boiler-houses and laundries, etc., and it is recommended that these should be at 2 ft. 0 in. intervals after 10 ft. 0 in. Similarly, total floor depths, inclusive of finish, structural slab, beams, services and suspended ceilings and roof depths from top of coping to soffit of suspended ceiling should be considered as a zone in which variations in depth may be made to suit variations in structural members to accommodate changes in loading span and materials and the extent of engineering services. It is recommended that these zones should be determined in increments of 1 ft. 0 in. Development work has shown that they fall between 2 ft. 0 in. and 7 ft. 0 in. In all residential building the floor-to-floor height should be that recommended by the Ministry of Housing and Local Government, viz. 8 ft. 4 ins.*

41. The adoption of 1 ft. 0 in. increments for the dimensions of the floor and roof zones will permit the evolution of a limited range of components and assembly dimensions to fill the spaces between these zones. For example, partitions and door assemblies can be designed to a limited range of these vertical dimensions corresponding to the three preferred dimensions for clear room height, viz. 8 ft. 0 in., 9 ft. 0 in. and 10 ft. 0 in. Further, the use of the 1 ft. 0 in. increment imposes a need to correlate floors, roof and clear room heights with changes in level, and a 1 ft. 0 in. vertical increment is therefore recommended for changes in level between similar situations.

42. Figure 1 illustrates these principles in relation to:

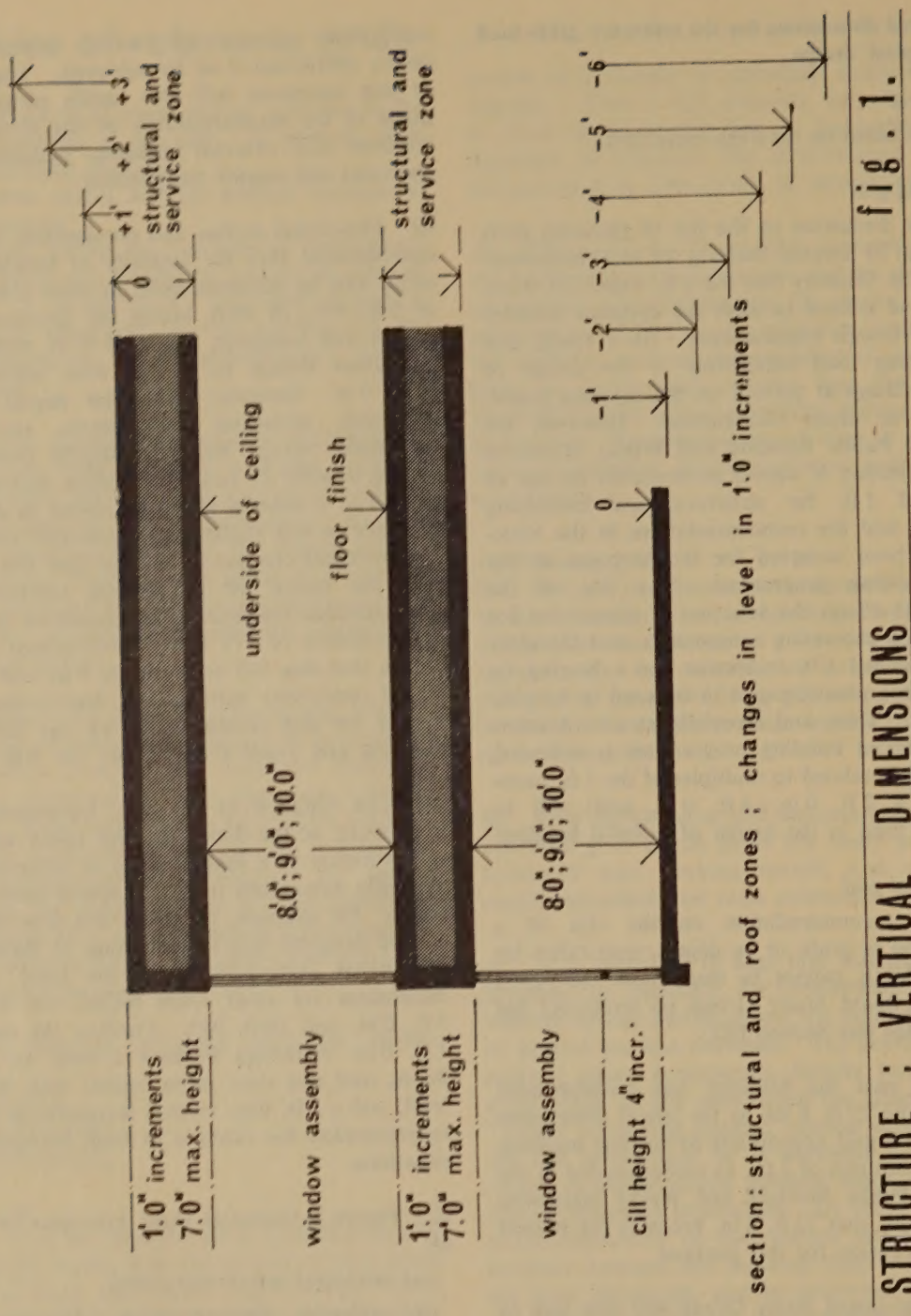
(*a*) structural and service zones;

(*b*) preferred floor-to-ceiling dimensions for standard departments;

(*c*) changes in floor levels.

43. Figure 2 illustrates, in further detail, the application of the preferred floor-to-ceiling dimensions to all departments. (The non-standard departments referred to would include, for example, gymnasia, boiler-houses, laundries, and possible central kitchens). It also shows the feasibility of altering by 1 ft. 0 in. increments the depth of the structural and service zone to provide for either an increased floor-to-ceiling dimension or further space in the structural and service zone. For example, if a common floor-to-ceiling height of 9 ft. 0 in. was generally adopted

* Design Bulletin No. 8. Ministry of Housing and Local Government.



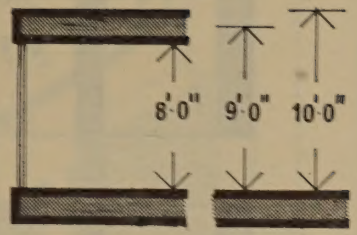
STRUCTURE : VERTICAL DIMENSIONS fig. 1.

in a project for functional and economic reasons, over some areas (operating theatres, diagnostic x-ray rooms) the required 10 ft. 0 in. floor-to-ceiling height would be provided by reducing the structural and service zone.

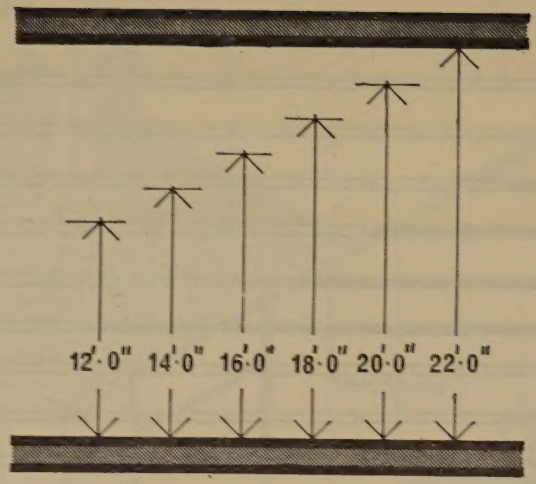
44. Figure 3 illustrates the evolution of a short range of six standard partitions from the preferred 1 ft. 0 in. vertical and 4 ins. horizontal dimensions. The partitions are shown arranged in various combinations in length to occupy any horizontal space which is a multiple of 4 ins. and over 6 ft. 8 ins., and some spaces below.

45. Figure 4 illustrates how various dimensionally co-ordinated components may be assembled within the preferred vertical and horizontal disciplines.

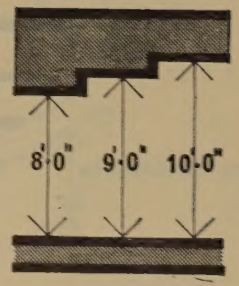
46. These proposals for structural and service zones, floor-to-ceiling dimensions, changes in level and the use of 1 ft. 0 in. for increments in planning grids, although evolved primarily for application to hospital buildings, are also recommended for local authority health and welfare buildings, with exceptions (see para. 1).



A. section : standard departments



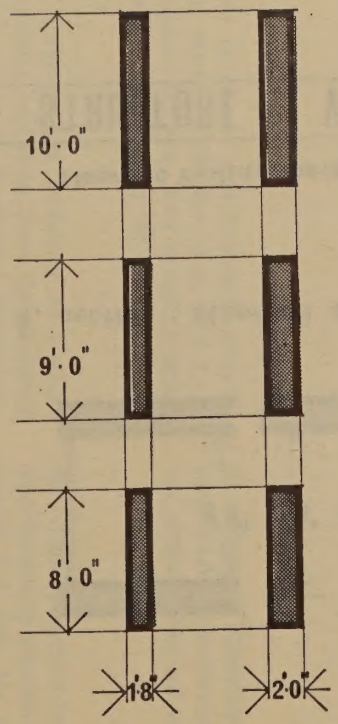
B. section : non-standard departments
e.g. gymnasia



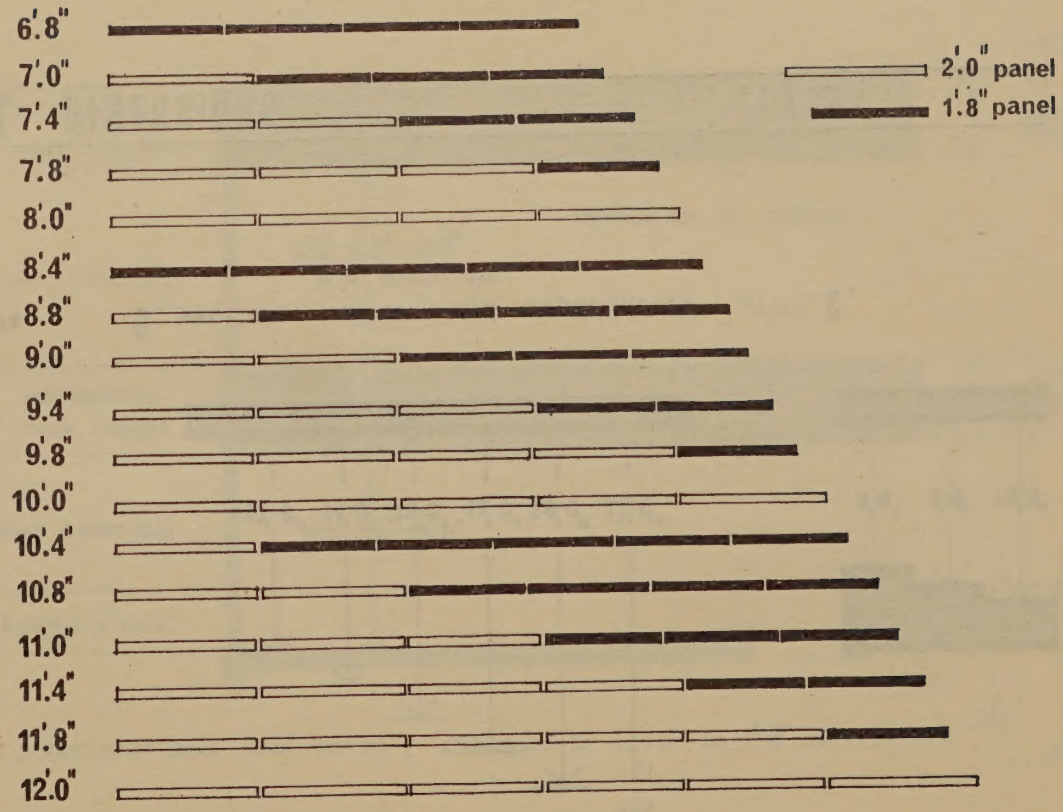
C.

floor to ceiling heights

STRUCTURE : VERTICAL DIMENSIONS fig.2.

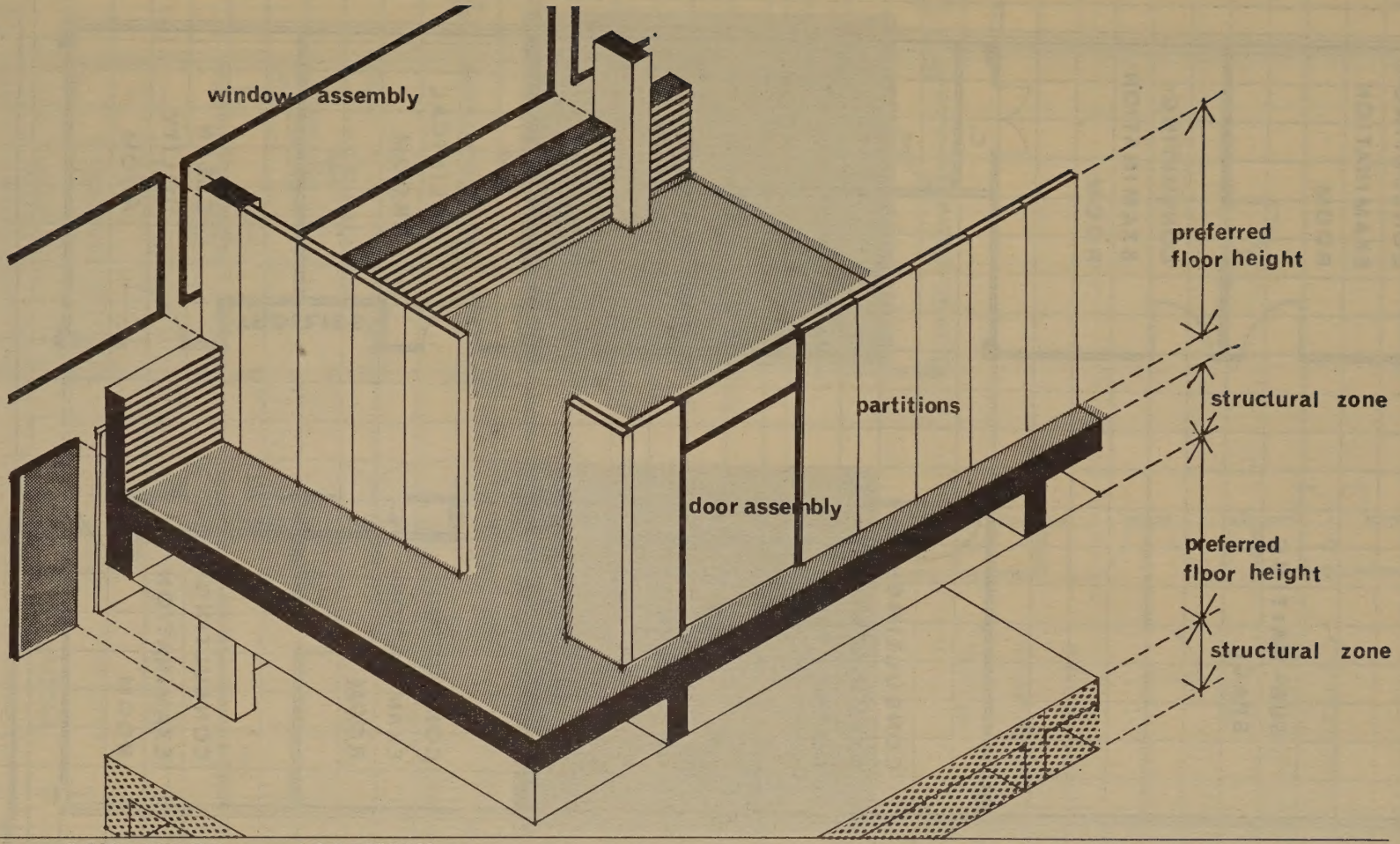


partition size range



PARTITIONS : PREFERRED RANGE

fig. 3.



COMPONENT ASSEMBLY

fig. 4.

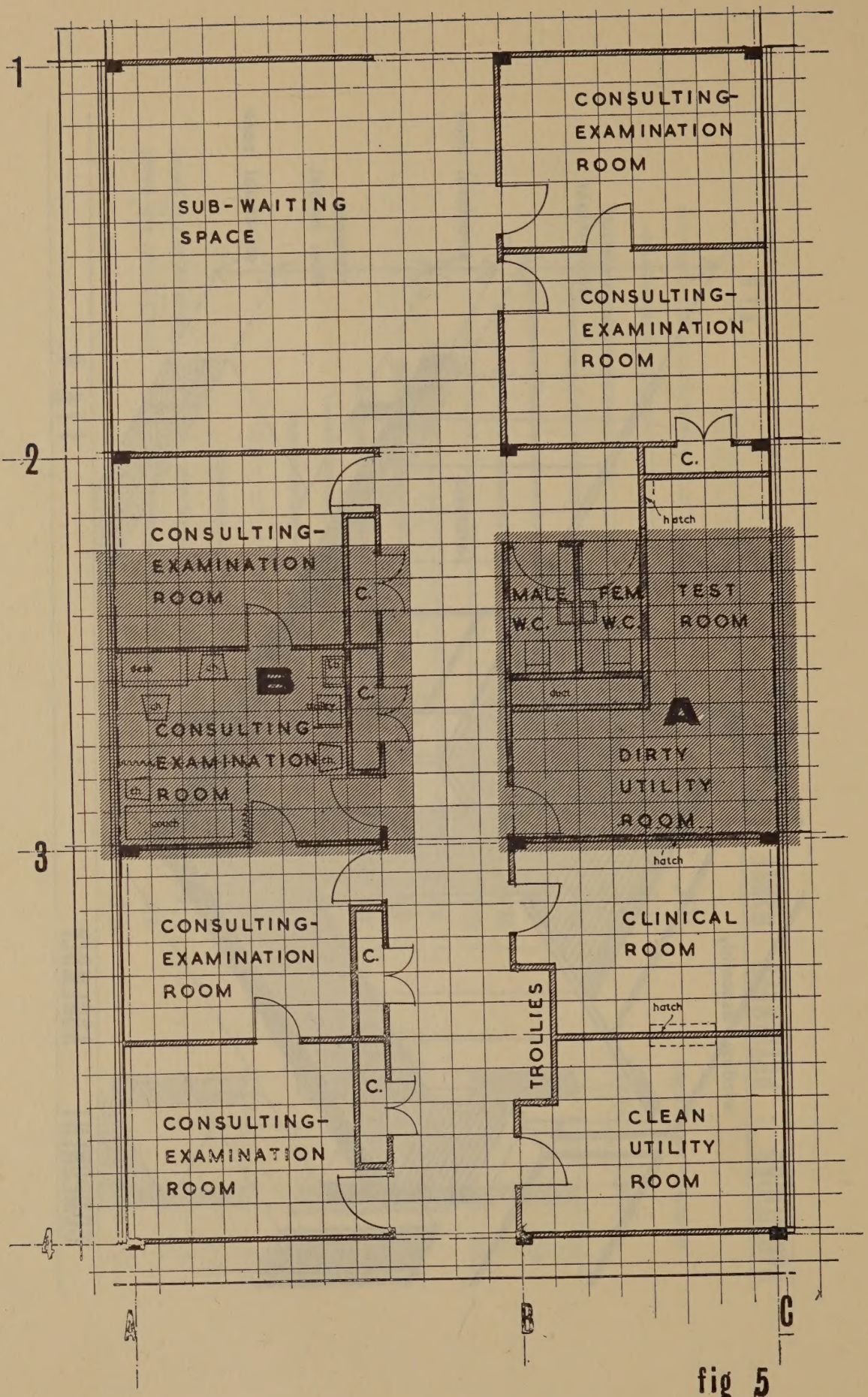
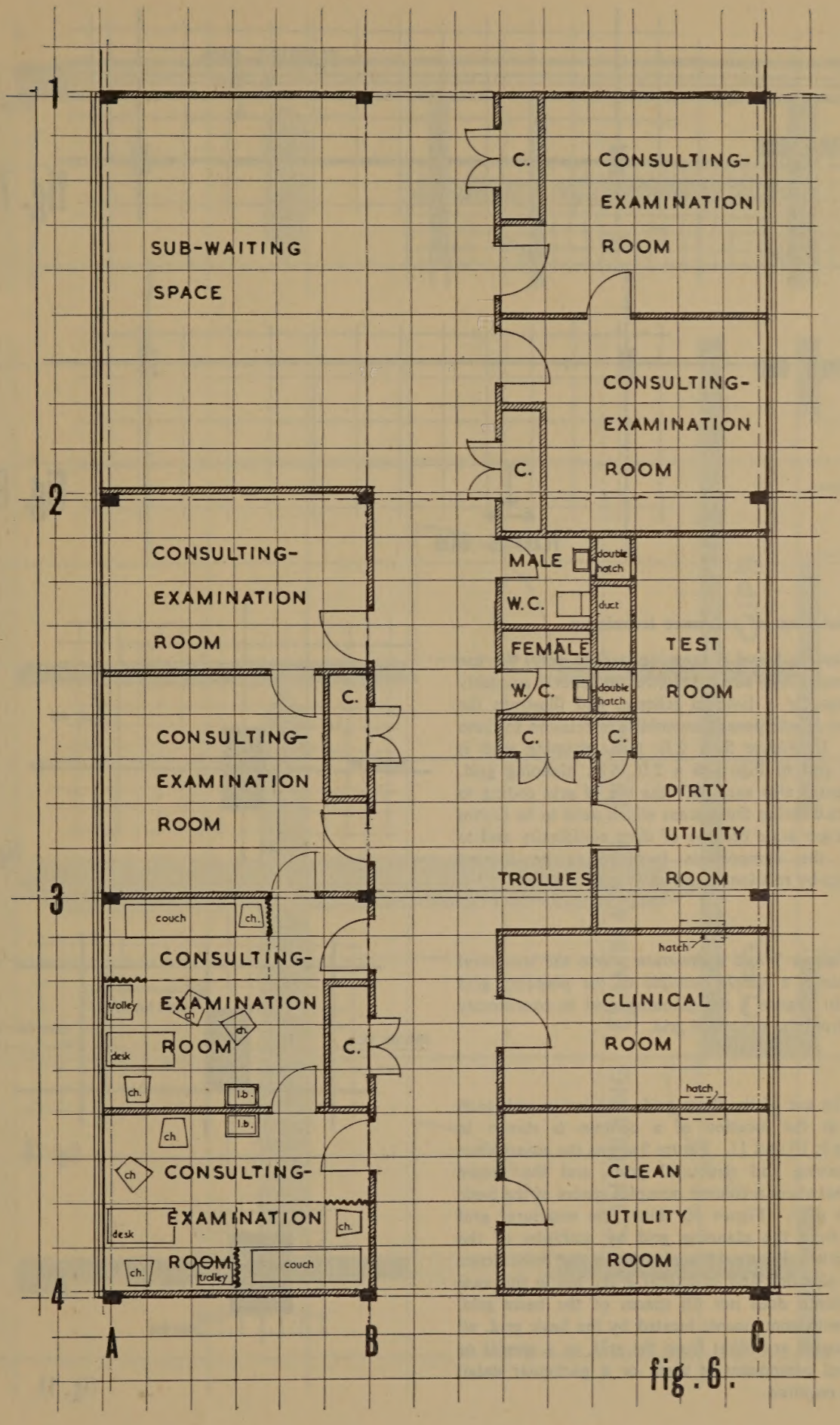

1
2
3
4
A
B
C
SUB-WAITING SPACE
CONSULTING-EXAMINATION ROOM
CONSULTING-EXAMINATION ROOM
CONSULTING-EXAMINATION ROOM
CONSULTING-EXAMINATION ROOM
CONSULTING-EXAMINATION ROOM
C.
C.
C.
C.
C.
hatch
MALE W.C.
FEM W.C.
TEST ROOM
A
DIRTY UTILITY ROOM
hatch
B
desk
ch.
table
couch
CLINICAL ROOM
hatch
TROLLIES
CLEAN UTILITY ROOM

fig 5


1
2
3
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A
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C
SUB-WAITING SPACE
C.
CONSULTING-EXAMINATION ROOM
CONSULTING-EXAMINATION ROOM
C.
CONSULTING-EXAMINATION ROOM
C.
CONSULTING-EXAMINATION ROOM
couch
ch.
CONSULTING-EXAMINATION ROOM
trolley
ch.
desk
C.
l.b.
CONSULTING-EXAMINATION ROOM
desk
ch.
trolley
couch
MALE
double hatch
W.C.
duct
FEMALE
TEST ROOM
W.C.
double hatch
C.
C.
DIRTY UTILITY ROOM
TROLLIES
hatch
CLINICAL ROOM
hatch
CLEAN UTILITY ROOM

fig. 6.

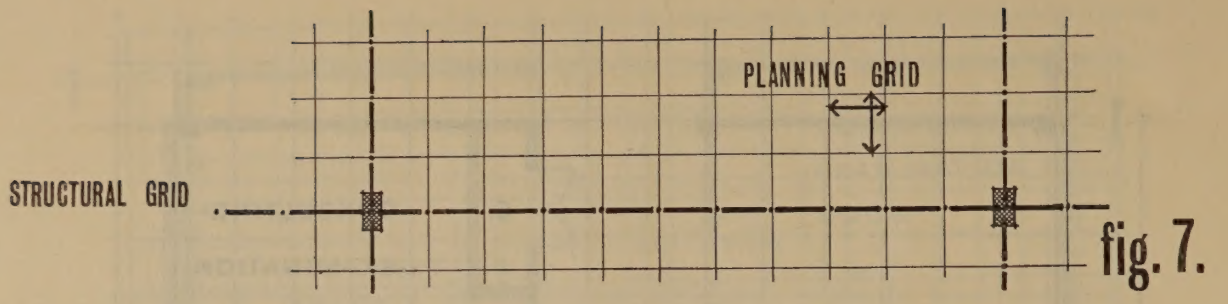


fig. 7.

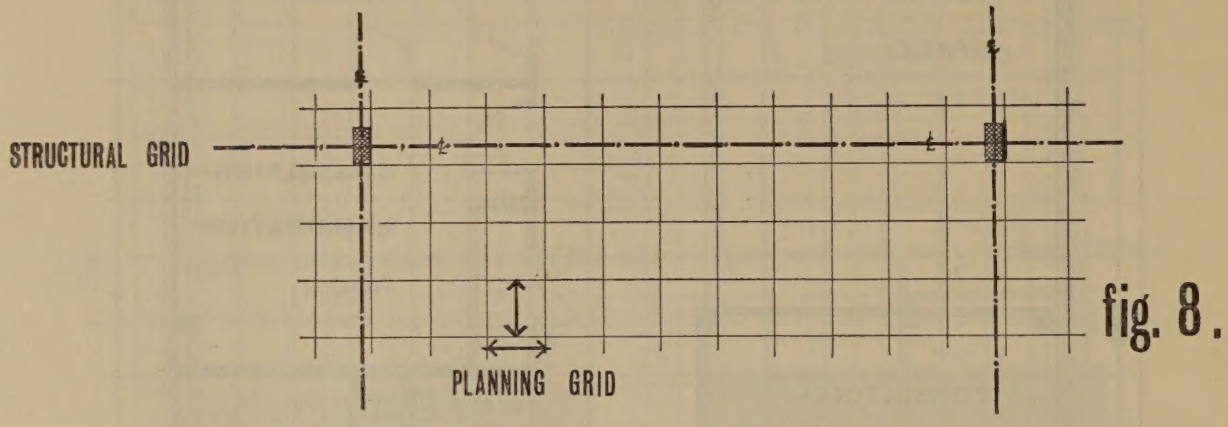


fig. 8.

(c) Illustration of reference techniques

47. Figures 5 and 6 show (in outline only) the use of planning and structural grids in general assembly drawings for a hospital scheme, and illustrate the location of component assemblies in relation to these grids. In Figure 5, a 2 ft. 0 in. planning grid is shown and in Figure 6 a 2 ft. 8 in. planning grid. The figures also exemplify the use of grid coding to assist in defining those areas which need to be drawn to a larger scale because of their complexity and to permit the components involved to be located precisely by relation to the basic grid.

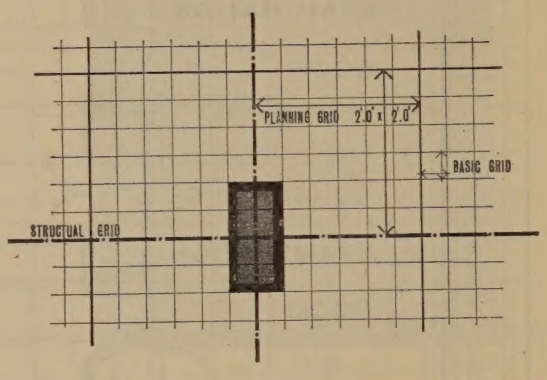


fig. 9

48. Figures 7 and 8 illustrate where the structural grid size is a simple multiple of the planning grid size. In Figure 8 the planning grid is consistently offset from the structural grid.

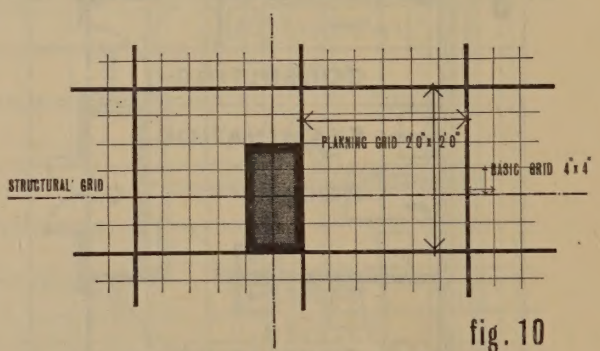


fig. 10

49. The use of the three grids in relation with each other in the location of a column is shown in Figures 9, 10 and 11. Figure 9 shows the coincidence of planning and structural grids, and the simple situation where a column occupies spaces of the basic grid in plan. Figure 10 shows the structural grid offset from the planning grid by multiples of the basic grid. Figure 11 again shows the coincidence of the planning and structural grids, but in this case the column does not fill spaces of the basic grid. Here, with components located by the basic grid, all components are offset from the grid, or a special or modified component is used, or a particular detail will be required.

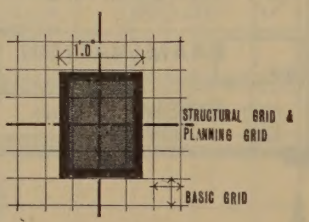
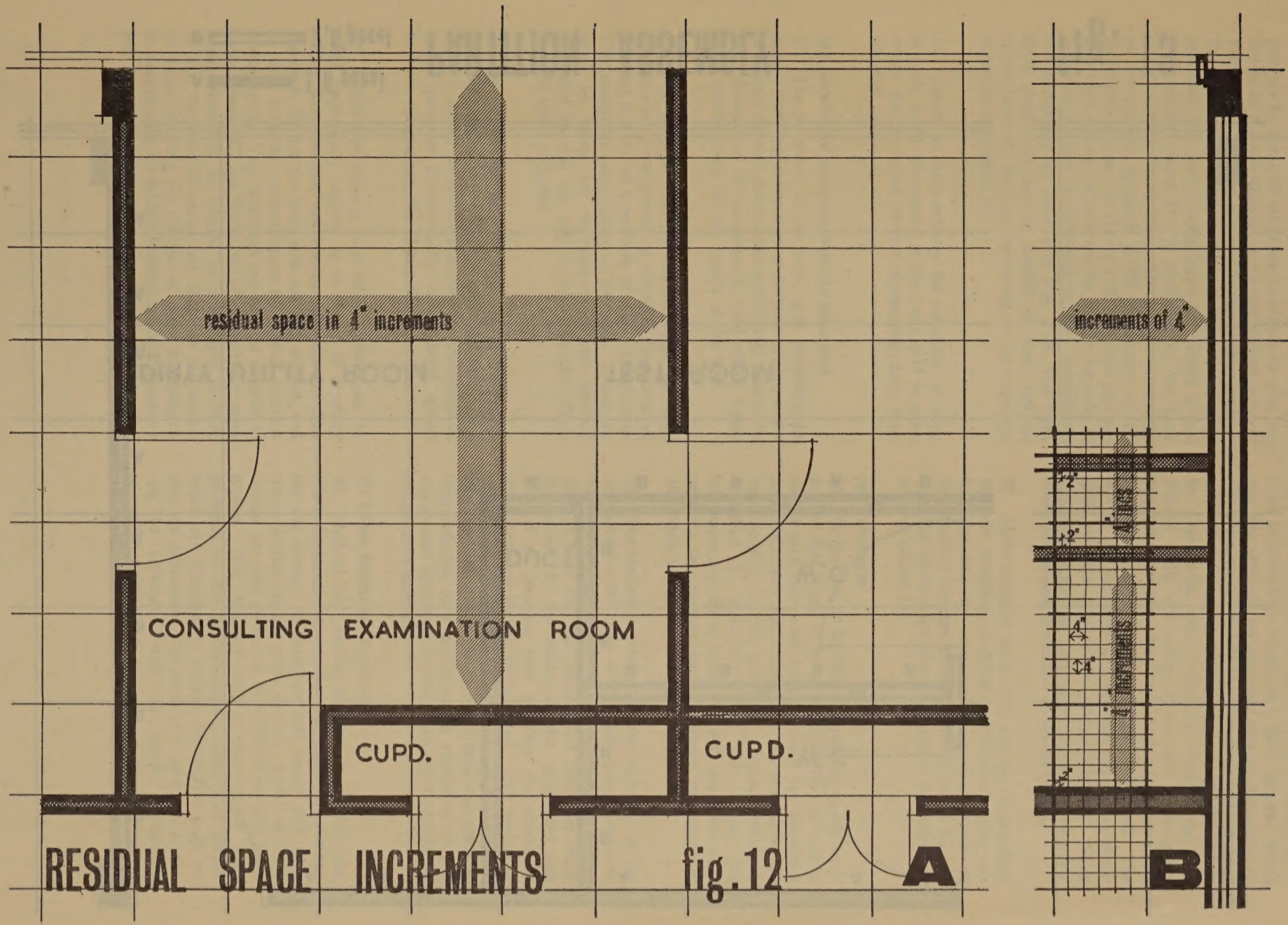
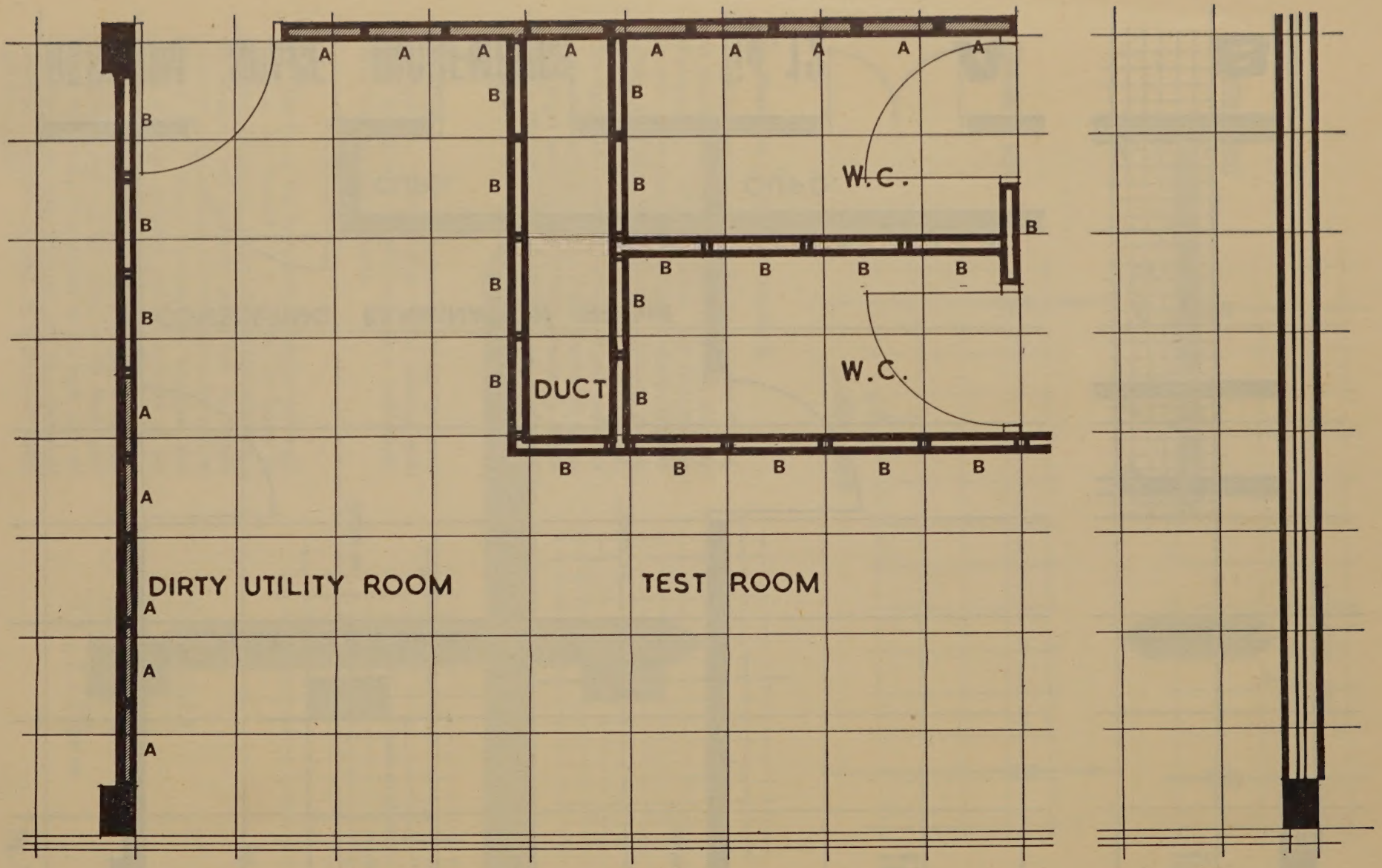


fig. 11



RESIDUAL SPACE INCREMENTS fig. 12



PARTITION ASSEMBLY

fig. 13

50. The basic principles involved in locating components by the grid reference technique in plan are shown in Figures 12 and 13, i.e. the shaded areas of Figure 5 to a larger scale. Figure 12 demonstrates the use of an assembly of dimensionally co-ordinated partitions and doors: components are located so that the residual spaces are in multiples of the 4 ins. increment (see Figure 12A). This allows for a range of components designed to fill increments of the basic grid in plan. In Figure 12B, the basic grid has also been shown, to indicate the precise location of components, and to demonstrate that components not occupying the basic grid (e.g. 2 ins. and 6 ins. thick partitions) can be located to leave residual spaces based on the 4 ins. increment, or the technique described for Figure 12.

51. Figure 13 demonstrates the assembly of components to fill increments of the basic grid in plan, where the preferred vertical dimensions have been adopted.

(d) Location of components to the basic grid

52. The adoption of the basic grid simplifies the precise location of components in plan subject to the preferred vertical dimensions particularly where the plan dimensions of components, used either singly or in combination, fill the spaces of the grid.

53. The simplest situation occurs when the total thickness of a component or assembly (including all finishes) is 4 ins. or a multiple of 4 ins. in thickness. This minimises complication at junctions. Allowance must be made for manufacturing and erection tolerance so that the unit is easily located within the grid space allocated.

54. A component may or may not be located to coincide with a grid line; but whatever decision is made it should be applied consistently throughout so as to preserve dimensionally co-ordinated spaces between components (see Figure 12).

55. When a partition is 3 ins. finished thickness, the most appropriate method is to locate it centrally within the basic grid so that the junction and trim members fill out the basic grid space in section, and to deal with the residual space by special junction components. This technique can also be applied to components of 2 ins. thickness; or alternatively, such components can be located in a half-grid position so that the residual spaces are based on increments of 4 ins., allowing for the use of other components in combination to fill the residual space if necessary (see Figure 12).

56. It is convenient by the nature of the material to treat brickwork in length as a fluid material which can be adjusted on the site, and in thickness by allocating to it the next largest multiple of the basic grid. For example, a 4½ ins. wall can be located in an 8 ins. wide zone; similarly, 9 ins./11 ins. and 13½ ins. walls will occupy 12 ins. and 16 ins. zones respectively, with either one face lying on the plane of the grid (see Figure 12) or centrally located. The size of the minimum gap between the planes of the grid and the material is comparable, and filling components will be required at junctions with other materials located in relation to the basic grid.

57. More complex assemblies, e.g. the relationships between structure, cladding and internal walls, can be simplified by establishing a clear plane of demarcation between cladding and structure on one side, and room space and partitions on the other (see Figures 12 and 13).

(e) Tolerances

58. In practice, in locating components to the basic grid so that singly or in combination they fill spaces of the grid, allowance must be made for variations in manufacture and erection. These variations can be controlled by one system of tolerance, which is described in B.S.3626: 1963, "A system for tolerances and fits in building", and establishes conventions for common use by designer, manufacturer and constructor.

59. The method is briefly that the basic size of the component is the same as the basic space dimension which it is to occupy, but its actual size must be less than its basic size; the difference or deduction being determined by the nature of the component and method of jointing, thus enabling the actual or manufacturing size to be achieved. This system is applicable to all types of components and ensures that they will always fill the spaces allocated to them, thus reducing to a minimum the possibility of one component infringing on the space which should be occupied by another.

(f) Loose fittings and equipment

60. Medical and nursing practice in hospital and health buildings requires the use of movable fittings, for the storage of materials and goods and their transportation to the point of use. Many of these fittings are used or stored in combination with fixed fittings. The Ministry will in due course issue guidance on the dimensionally co-ordinated spaces which are functionally suitable for these fittings, so that the dimensions and designs of loose equipment can be correlated with the general principles advocated in this Note.

VIII. Selection of components

61. To implement industrialised building in the hospital field it is necessary to select a limited range of standard and dimensionally co-ordinated components which can be used in combination to meet the functional and user requirements postulated. Many of the components so related will be suitable for other health and possibly welfare buildings.

62. The selection of the preferred dimensions for components involves study of a number of factors, which are of varying significance for each component:

(*a*) type of component;
(*b*) functional requirements;
(*c*) determination of sizes;
(*d*) production factors;
(*e*) variety reduction.

(a) Type of component

63. Some components, e.g. partitions, windows, ceiling panels, etc., are commonly used in multiples, or in combination with each other and frequently in long runs, and thus require an inter-related range of preferred dimensions. Others can be employed singly and so can be considered initially in relation to their own specific space requirement, though their relationship to adjacent components should also be considered in design. Components such as structural beams need not be dimensioned to achieve the same degree of flexibility because of their function and conditions of use, but maximum correlation of sizes is still required to achieve variety reduction.

(b) Functional requirements

64. Evaluation of the significance of this factor involves, depending on the type of component, examination of such considerations as e.g. sound properties, stability, weight, erection needs, articles to be stored in cupboards, doors wide enough to permit beds to pass, working heights for cupboards, window design derived from anthropometric and other data, etc.

(c) Determination of sizes

65. Sizes should be determined initially from the results of study of functional requirements and then related to the preferred increments/dimensions selected for hospital buildings. The method will normally be to treat each of the three dimensions in turn. Thus, in thickness, increments are related to the 4 ins. or 1 in. increments; in length, dimensions to achieve a range of preferred sizes using the 4 ins. increment which in combination fill multiples of the 4 ins. basic grid, should be aimed at; vertically, dimensions (e.g. for heights of partitioning, door assemblies and some window units) will be required to suit the preferred clear floor-to-ceiling dimensions which (see paragraph 39 *et sequendum*) are appropriate to hospital building.

(d) Production factors

66. The significance of manufacturing problems can be established in consultation with manufacturers. Such problems include the degree of standardisation capable of attainment in the factory, method of manufacture, costs of tooling up, handling, stock piling and transportation, and co-ordination with the British Standards Institution.

(e) Variety reduction

67. To achieve the full benefits of the industrialisation of hospital building it is essential to achieve for the hospital programme the minimum range of components which can become manufacturers' standard components (as distinct from components standardised for one or more hospital projects only) but which satisfy the maximum number of applications. This will require several stages of work: an assessment of the total range of components needed; consultation with manufacturers to establish economic runs; estimation of demand, etc. Components with a limited use in practice could be eliminated from the range with a minimum effect on the general aim of variety reduction of all components used in hospital building.

IX. Implementation

68. To implement the principles of industrialised building for the hospital building programme, the Ministry in conjunction with Regional Hospital Boards and private practitioners have set up architectural, quantity surveying and engineering Inter-Board Study Groups.

69. The objectives of the groups for these disciplines can be summarised as follows:

(*a*) co-ordination of existing and production of new components to the recommended range of preferred dimensions;
(*b*) techniques of design communication and cost information stemming from the use of dimensionally co-ordinated components;
(*c*) management techniques, e.g. contractural and programme building methods;
(*d*) classification and rationalisation of detailed user-data for hospital departments.

The results of the work of these Groups will be published in subsequent Design Notes.

70. Although the study groups are manned essentially by one particular discipline, other disciplines

co-operate at appropriate stages of the work according to the nature of the subject under study, and consultation with manufacturers is also undertaken.

71. An important aspect of the organisation of the groups is that the use of common grid reference techniques enables the work of the diverse groups to be co-ordinated through steering committees, which can ensure adherence to the common discipline imposed by the national system of preferred increments and dimensions.

72. As each Inter-Board Group formulates its conclusions on the designs of components the following steps will be taken:

(*a*) manufacture of prototypes;

(*b*) evaluation of prototypes on a small pilot project;

(*c*) application of variety reduction after testing on a large project;

(*d*) amending of prototypes;

(*e*) implementation of programme procedures, e.g. bulk ordering, manufacturing, supply.

73. These groups represent a new departure in design work in that they bring to the service of the hospital building programme a partnership of official and private practitioners (architects, quantity surveyors and engineers) engaged in the development and practical application of ideas which could have far-reaching effects throughout the whole constructural field. The groups are listed below.

(a) Architectural Study Groups

74. The Ministry, in conjunction with Regional Hospital Boards, set up in August, 1962, five Inter-Board Study Groups. In February, 1963, the response by private architects to an invitation to co-operate in the work of the groups enabled five more to be set up. In co-ordination with the Scottish Development Department one group is based in Scotland, another is based in Northern Ireland under the aegis of the Northern Ireland Ministry of Health and Local Government, and another under the Welsh Board of Health.

75. ***Information***

Objective

To consider and make recommendations for the improved communication of information in relation to individual projects, in order to achieve earlier completion of these projects within the cost limit system. The study embodies all stages in the project from the acceptance of the brief to the final account.

76. ***Storage***

Objective

To establish the particular internal function requirements of storage units to suit the maximum variety of needs, taking into account changing hospital practice and providing for maximum flexibility in use.

77. ***Door assemblies***

Objective

To assess the general functional requirements of door assemblies for all locations in hospital buildings and to establish a range of door and frame assemblies.

78. ***Floor finishes***

Objective

To determine the functional requirements for floor finishes in relation to location and use, and to establish a limited range of floor finishes for use in hospital buildings.

79. ***Sanitary equipment***

Objective

To study sanitary appliances and fittings in relation to functional requirements, etc., and to recommend a suitable range for use in hospitals.

80. ***User requirements***

Objective

To initiate a standard method of presenting user requirement information for verification by project teams, and to co-ordinate similar studies on a national basis.

81. ***Structures***

Objective

To prepare basic criteria for the design of hospital structures.

82. ***External cladding***

Objective

To determine the functional requirements of windows and cladding required for hospital buildings, and to establish a range of window and cladding units.

83. ***Partitions Group (Scotland)***

Objective

To determine the functional requirements of partitions and their finishes for various activities, and produce a suitable range of partitions.

84. ***Ceilings and Light Fittings Group (Northern Ireland)***

Objective

To determine the functional requirements of ceiling finishes and to establish suitable ceiling finishes.

85. ***External works and access (Wales)***

Objective

To determine the functional requirements of

the external works and access to hospitals and to establish suitable principles and details.

(b) Quantity Surveyors groups

86. The following Study Groups of Quantity Surveyors were formed in May, 1963.

87. ***Liaison with architects, and specifications***
Objective

To provide quantity surveying advice and information to the Architects' Study Groups.

88. ***Cost planning techniques***
Objective

To consider and make recommendations as to the most suitable techniques and systems of cost planning for hospital building projects.

89. ***Preparation and layout of tender documents***
Objective

To develop, with the Architects' Information Group, techniques in respect of tender documents.

90. ***Term contracts for maintenance and minor works***
Objective

To consider and report on the feasibility of using term contracts for the execution of maintenance and minor works on hospital property.

91. ***Building cost indices***
Objective

To consider and make recommendations for the setting up a uniform system of assessing, recording and forecasting changes in the cost of construction for hospital buildings.

(c) Engineering study groups

92. In March 1963 the Ministry and Regional Hospital Boards Engineers formed a Steering Committee on Inter-Board Study which in May 1963 set up six Inter-Board Study Groups.

93. ***Basic standard specifications for engineering services***
Objective

To prepare basic standard specifications for hospital engineering services for use by Regional Boards and Boards of Governors.

94. ***Variety reduction of engineering plant and equipment***
Objective

To consider the components of mechanical and electrical engineering services of hospitals in relation to the possibility of standardisation or of reducing the variety of choice.

95. ***Use of standard details***
Objective

To investigate the use of standard engineering plans and details in order to save design time on hospital building projects.

96. ***Impact of industrialised building and dimensional co-ordination on engineering services***
Objective

To consider the effect of industrialised building on the engineering services, especially as regards dimensional co-ordination and prefabrication.

97. ***Accommodation and access for installation and maintenance of engineering services***
Objective

To issue guidance on space requirements, and access for installation and maintenance of hospital engineering services.

98. ***Capital, running, and maintenance cost and depreciation aspects of engineering design group***
Objective

To issue guidance on cost and design aspects of alternative solutions to engineering problems.

APPENDIX

Glossary of terms

1. **Dimensional co-ordination:** Co-ordination of dimensions to enable components to be used together and without modification.
2. **Reference system:** A system of lines, points and planes to which measurements and positions of building components may be related.
3. **Section:** Building material formed to a definite cross-section but of unspecified length, e.g. joists, tubes, pipes.
4. **Unit:** Building material formed as a simple article with all three dimensions specified, complete in itself but intended to be part of a compound unit or complete building.
5. **Compound unit:** Building material formed as a complex article with all three dimensions specified, complete in itself but intended to be part of a complete building.
6. **Component:** A section, unit or compound unit contributing to the composition of a whole building.
7. **Assembly:** A combination of components forming the whole or part of a building.
8. **Tolerance:** The difference between the upper and corresponding lower limit of the actual size of a component.
9. **Manufacturing tolerance:** An allowance for the lack of accuracy permitted for the production of a component.
10. **Position tolerance:** An allowance for the lack of accuracy which must be accepted for the positioning of a component on site.
11. **Minimum gap:** The necessary minimum distance between a component and its bounding planes. This depends on the nature of the components and method used for making its joints.
12. **Minimum deduction:** The difference between the basic size and corresponding maximum size of a component. This is equal to twice the minimum gap plus the position tolerance.
13. **Maximum size:** The upper limit of a component: the actual size must not exceed this.
14. **Maximum deduction:** The difference between the basic size and the corresponding minimum size of a component. This is equal to twice the minimum gap plus position tolerance plus manufacturing tolerance.
15. **Minimum size:** The lower limit of a component: the actual size must not be less than this.

MINISTRY OF HEALTH

Addendum to Hospital Design Note No. 1. **Appendix II**

Dimensional Co-ordination and Industrialised Building

This Appendix gives recommended preferred dimensions for a number of components used in hospital building. Where the dimensions given are recommended basic sizes for components (from which manufacturing sizes can be determined by deducting appropriate tolerances) they are given in heavy type. Where it is not yet possible to recommend preferred dimensions guidance is given on the dimensional framework within which these may be evolved.

The information given is summarised from the Design Notes distributed in draft form or to be distributed and published, containing the Reports of the Inter-Board Study Groups (paragraphs 68 *et seq.* of Design Note No. 1) which should be consulted for discussion of the principles leading to the establishment of the dimensions, and for practical guidance on their use in the design and manufacture of the components.

HORIZONTAL DIMENSIONS FOR STRUCTURE

1. **Zones for structural walls and columns**
   4 ins. 8 ins. 12 ins. 16 ins. 24 ins.
2. **Spacing of structural walls and columns**
   Based on 2 ft. 0 in.
   8 ft. 0 in. **10 ft. 0 in.** 12 ft. 0 in. 16 ft. 0 in. **20 ft. 0 in. 22 ft.0 in. 24 ft. 0 in,** 28 ft. 0 in. 32 ft. 0 in.

VERTICAL DIMENSIONS FOR STRUCTURE

3. **Zones for floors and roofs**
   1 ft. 0 in. 2 ft. 0 in. 3 ft. 0 in. 4 ft. 0 in. 5 ft. 0 in. 6 ft. 0 in. 7 ft. 0 in. (see para. 40)
4. **Floor to ceiling heights**
   8 ft. 0 in. 9 ft. 0 in. 10 ft. 0 in (standard department see para. 40)
   12 ft. 0 in. 14 ft. 0 in. 16 ft. 0 in. 18 ft. 0 in. 20 ft. 0 in. 22 ft. 0 in. (see para. 43)
5. **Floor to floor and floor to roof heights**
   9 ft. 0 in. 10 ft. 0 in. 11 ft. 0 in. 12 ft.0 in. 13 ft. 0 in. 14 ft. 0 in. (preferred for multi-storey buildings)
   15 ft. 0 in. 16 ft. 0 in. (used with deep structural and service zones)
   17 ft. 0 in. 18 ft. 0 in. 19 ft. 0 in. 20 ft. 0 in. 21 ft. 0 in. 22 ft. 0 in. 23 ft. 0 in. 24 ft. 0 in. 25 ft. 0 in. 26 ft. 0 in. (additional heights for single-storey buildings)

CHANGES OF LEVEL

6. 1 ft. 0 in. increments (see para. 41)

NON LOAD BEARING PARTITIONS

7. **Thickness**
   2 ins. **4 ins.** 6 ins. 8 ins.
8. **Width**
   1ft. 8 ins. 2ft. 0 in.
9. **Height**
   8 ft. 0 in. 9 ft. 0 in. 10 ft. 0 in.

DOOR FRAMES

10. **Width**
    4 ins. increments
    2 ft. 0 in. 3 ft. 0 in. 3 ft. 4 ins. 4 ft. 4 ins. **5 ft. 0 in. 6 ft. 4 ins.**
11. **Height**
    6 ft. 8 ins. **7 ft. 0 in.**
    8 ft. 0 in. 9 ft. 0 in. 10 ft. 0 in. (full height assembly)

WINDOWS

12. **Width**
    1 ft. 0 in. increments from 2 ft. 0 in.
13. **Height**
    4 ins. increments

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